

# Chapter 21

## Metals and Structures

# Metal Properties

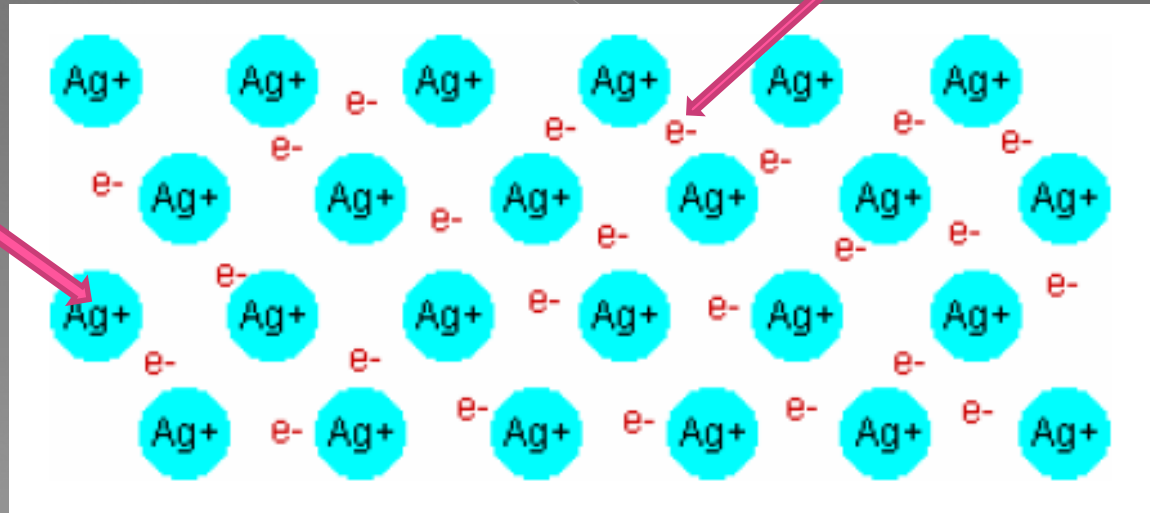
- Have high melting & boiling points
- Conduct electricity and heat
- Hard and dense
- Can be hammered into shapes (malleable)
- Can be drawn out into wires (they are ductile)



# Metallic Bonding

- Metal atoms, or ions, are held together by a 'sea' of electrons

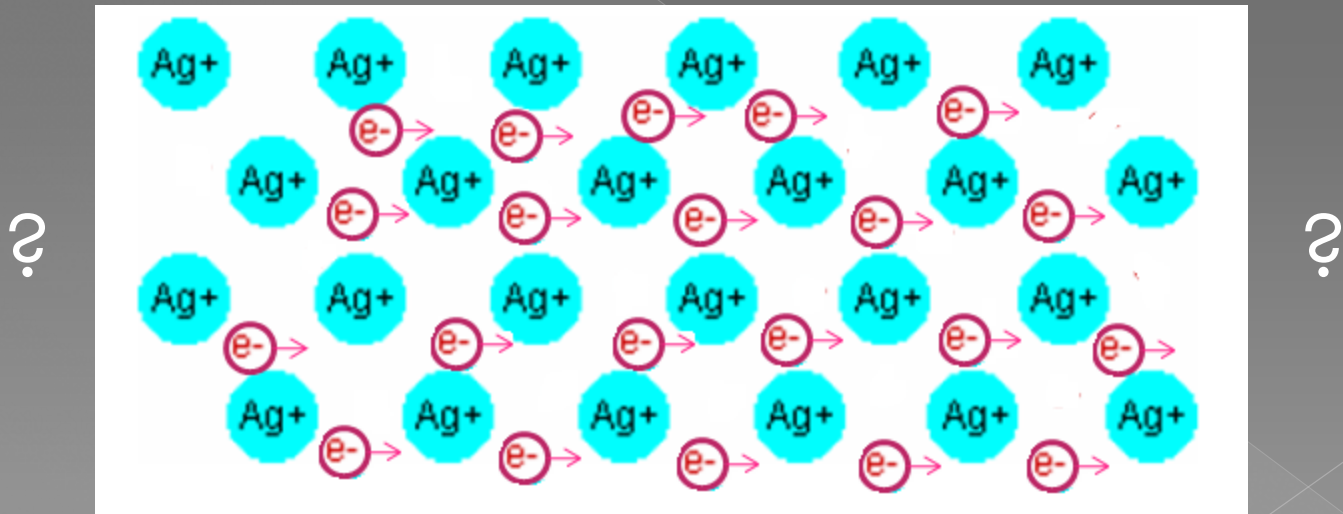
The 'sea' of electrons hold the metal atoms together



Metal atoms  
(considered as ions as  
they donate the  
electrons in their outer  
shell to the sea of  
electrons)

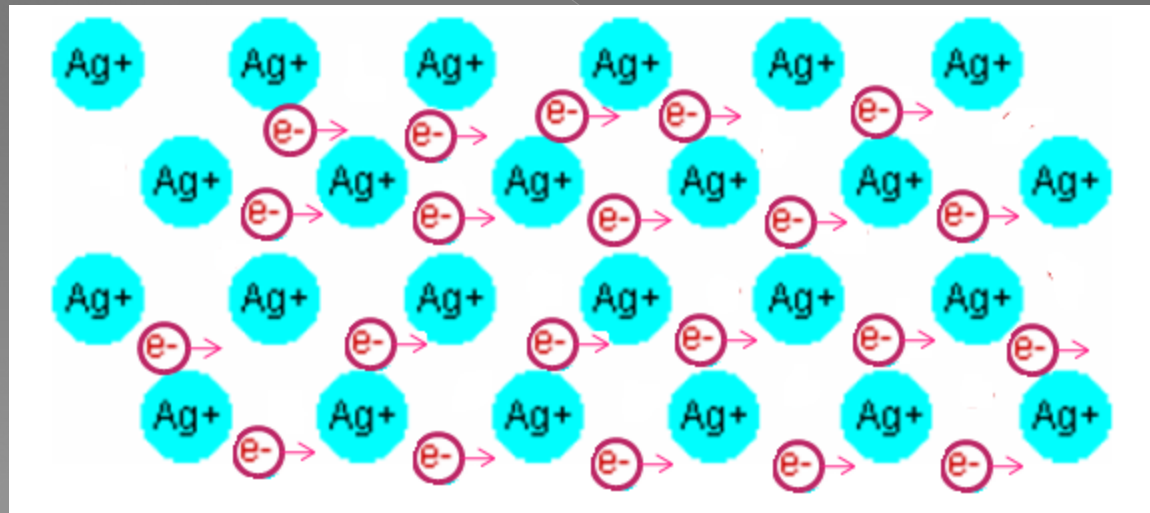
# Metallic Bonding

- What happens when one side of the metal is made positive and the other end negative?



# Metallic Bonding

- What happens when one side of the metal is made positive and the other end negative?

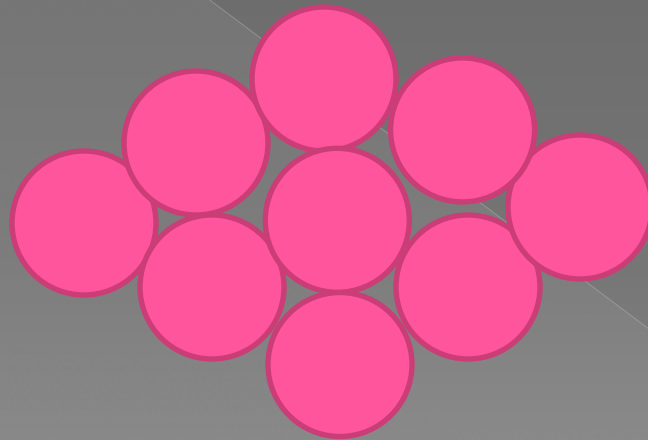


# Metallic Bonding

- In metallic bonding instead of sharing electrons between two atoms the electrons in the outer shells are shared amongst all the atoms with all the atoms positively charge. These atoms are attracted to the negatively charged 'sea' of electrons.
- The movement of the free electrons means that metallic bonded materials have good thermal and electrical conduction.

# Structure of Metals

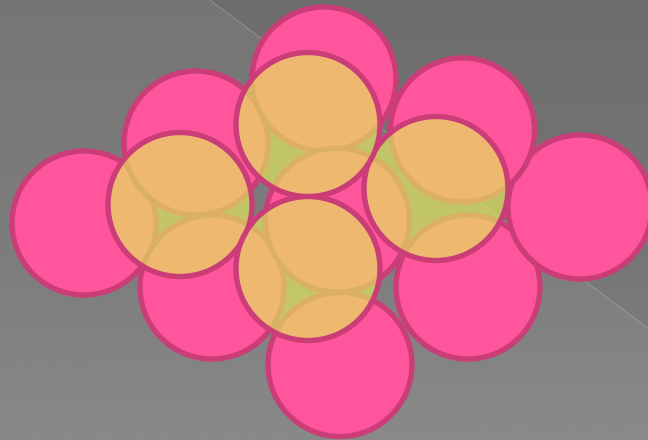
- The atoms of a metal are packed closely to each other in a giant structure.



- Let's say this is the first layer of the structure, where would you think you'll put the next layer?

# Structure of Metals

- ◉ The atoms of a metal are packed closely to each other in a giant structure.



- ◉ Does this explain why metals are dense and have high melting points?



# Alloys

- Alloys are **mixtures** of two or more metals formed together with other elements/materials to create new metals with improved properties and characteristics.
- E.g.        Brass (Copper and Zinc),  
              Stainless steel (steel and chromium)
- Alloy = metal A + metal B + ... + other elements
- Metals are **MIXED** together they **NEVER REACT WITH EACH OTHER.**



# What Alloys are Used to Make Aeroplanes?

- Generally, a number of different alloys are used in the Aerospace industry, ranging in uses from jet turbine blades to wings and fuselages. Aluminium alloys are very commonly used, as are alloys of:
  - > Magnesium (a very light alloy)
  - Nickel (has excellent high temperature properties)
  - Titanium (lightweight, very strong and corrosion resistant)
  - Zirconia (can withstand very high temperatures so is used for coating parts of jet engines)
- If pure aluminium was used then the wings would snap off!

# Properties of Alloys

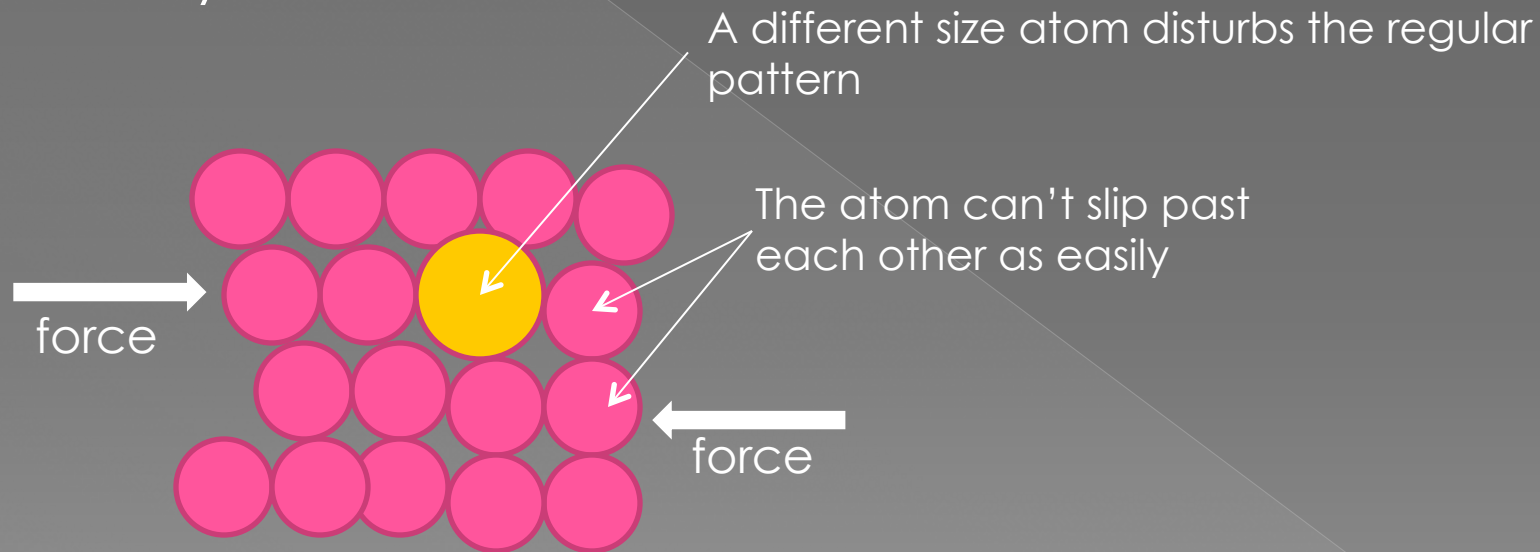
- ◉ In pure metals atoms are all the same size and therefore layers can slide over each other easily



- ◉ This is observed when metals are hit by a hammer and shaped into different shapes. [Malleable]

# Properties of Alloys

- What happens to the malleability of pure metals when they are mixed with other, changed to alloys?



- The layers can't pass as easily "jammed" and hence not as malleable. Therefore alloys are much stronger, harder and have higher heat resistance.

- Open to page 284 and let's look at the different alloys.